

REMARKS

The present invention relates to a process for the production of rigid foams containing urethane groups and predominantly isocyanurate groups. This process consists of reacting:

1) polyisocyanates;

with

2) from 30 to 90 parts by weight of compounds containing at least two isocyanate-reactive hydrogen atoms, having molecular weights of 400 to 10,000, and containing branched chains;

in the presence of

3) one or more C₁ to C₆ hydrocarbons as the sole blowing agents;

4) from 10 to 60 parts by weight of flameproofing agents;

and

5) from 10 to 20 parts by weight of compounds containing at least two isocyanate-reactive hydrogen atoms and having molecular weights of 32 to 399 as crosslinking agents;

and, optionally,

6) auxiliary agents and additives which are selected from the group consisting of emulsifiers, foam stabilizers, catalysts, reaction retarders, cell regulators, pigments, dyes, stabilizers against ageing and weathering, plasticizers, fungistatic agents, bacteriostatic agents and fillers.

The parts by weight of components (2), (4) and (5) totals 100 parts by weight, and the reaction is conducted at an isocyanate index of 200 to 600.

Claims 3-9 were rejected under 35 U.S.C. 103(a) as being unpatentable over the Volkert reference (U.S. Patent 5,096,933).

The Volkert reference is directed to a process for the preparation of rigid polyurethane foams having a low thermal conductivity. This process comprises reacting a) organic and/or modified organic polyisocyanates, with b) at least one higher molecular weight compound having at least two reactive hydrogen atoms, and optionally, c) lower molecular weight chain extending agents and/or crosslinking

agents in the presence of d) cyclopentane, or mixtures comprising cyclopentane and/or cyclohexane, or at least one compound that is homogeneously miscible with cyclopentane and/or cyclohexane, and which preferably has a boiling point below 35°C, and optionally, in combination with water, as well as in the presence of e) catalysts, and f) auxiliary agents and additives.

Applicants respectfully submit that the presently claimed invention is not rendered obvious by the Volkert reference (U.S. Patent 5,096,933).

It is not evident to one of ordinary skill in the art that dimensionally stable, flame-resistant polyurethane rigid foams exhibiting no surface brittleness can be prepared from the presently claimed combination upon reading the Volkert reference. This reference broadly discloses suitable blowing agents at column 8, line 42 through column 9, line 40. In particular, suitable blowing agents disclosed by the Volkert reference include cyclopentane; and mixtures of (1) cyclopentane, cyclohexane or a mixture thereof, and (2) at least one low boiling point compound homogeneously miscible with cyclopentane and/or cyclohexane, that preferably has a boiling point below 35°C. (See column 8, lines 42-50.)

It is further disclosed by the Volkert reference that these blowing agents can be used alone, or preferably in conjunction with water (see column 8, line 67 through column 9, line 1). Preferred blowing agents of this reference are a combination of cyclopentane and water; a combination of cyclopentane and/or cyclohexane, and water; a combination of cyclopentane and/or cyclohexane, water, and one or more low boiling alkanes (see column 9, lines 2-8). These preferred blowing agent combinations are further described in terms of specific blends of various parts by weight at column 9, lines 21-40 as determined by the boiling point of the mixture and desired low thermal conductivity of the rigid PU foams to be formed.

Applicants respectfully submit that the presently claimed process clearly excludes the presence of other blowing agents including water and low boiling compounds. The presently claimed invention is clearly limited to blowing agents consisting of one or more C₁ to C₆ hydrocarbons. Water and low boiling alkanes including the ethers and various halogenated (cyclo)alkanes of the Volkert reference are clearly outside the scope of the presently claimed invention.

Although the Volkert reference broadly discloses that the blowing agent may be only cyclopentane, cyclohexane or a mixture thereof, each of the working examples uses at least water (3.6 pbw) in combination with cyclopentane (10.9 pbw) (see Example 1). Examples 2-5 use a combination of a low boiling component, water, and cyclopentane or cyclohexane. Of these four (4) examples, i.e. Examples 2-5, Example 4 is the only example that uses a "low boiling component" which would fall within the scope of a C₁ to C₆ hydrocarbon as required by Applicants' claims. Example 4, however, also requires 3.0 pbw of water. It is apparent by the express claim language in Applicants' specification that water is clearly excluded as a blowing agent. Applicants respectfully submit that water is known to cause surface brittleness of foams due to the reaction between the isocyanate and water which eliminates carbon dioxide. Accordingly, one of ordinary skill in the art would clearly recognize that the foams of Examples 1 and 4 in the Volkert reference would exhibit surface brittleness.

The remaining Examples, i.e. Examples 2, 3 and 5, use a low boiling compound in addition to water and cyclopentane as blowing agents. The amount of water varies in these examples from 1.8 pbw (Example 5) to 3.5 pbw (Example 3), and the quantity of other blowing agent component or mixture thereof varies from 12 pbw (Example 3) to 16 pbw (Example 5). Examples 2 and 5 use partially fluorinated hydrocarbons, and Example 3 uses an ether, specifically diethylether. The skilled artisan would also expect the foam formed in Example 3 to exhibit surface brittleness due to elimination of carbon dioxide from the isocyanate-water reaction. The foams prepared in Examples 2 and 5 were prepared with a partially fluorinated hydrocarbon, and are clearly irrelevant to the patentability of the presently claimed invention.

It is respectfully submit that the Volkert reference simply does not provide sufficient guidance or information to one of ordinary skill in the art such that the skilled artisan could reasonably expect to produce a rigid foam that is flame resistant and dimensionally stable while being free of surface brittleness from the presently claimed combination of components at the presently required isocyanate index. One of ordinary skill in the art would simply not expect that the presently required combination of components which includes one or more C₁ to C₆ hydrocarbons as

the sole blowing agent, when reacted at an isocyanate index of 200 to 600 would result in rigid foams that are flame resistant, dimensionally stable, and free of surface brittleness.

Applicants respectfully submit that the Declaration of Dr. Freiderichs submitted by Applicants' with their response on July 31, 2002, fully supports their position that simply modifying the examples of the Volkert reference by (1) omitting water and other blowing agents outside the scope of the present claim language, and (2) increasing the NCO Index of these examples to the presently claimed range does not result in rigid foams which are flame resistant and dimensionally stable without exhibiting surface brittleness. It is only by following the presently claimed invention that one can produce such foams.

It is apparent from the Declaration of Dr. Friederichs that all of the examples therein are comparative examples, i.e. these examples are outside the scope of Applicants' claimed process. Comparison Example 1 in this declaration is a repeat of Example 1 of U.S. Patent 5,096,933. See declaration, page 2, 3rd and 4th paragraphs, and page 3, 1st paragraph. This foam is dimensionally stable, but has a brittle surface.

The next comparison example, Comparison Example 2, demonstrates the error in the Examiner's logic that one can simply omit the water from the formulations of the Volkert reference. Comparison Example 2 uses the same formulation as Comparison Example 1, except that water is omitted. See the Declaration on page 3, 2nd, 3rd and 4th full paragraphs. This example, which theoretically falls within the broad scope of the Volkert reference, results in a foam having the same density as the foam from Comparison Example 1, but that exhibits strong shrinkage and is not dimensionally stable. Therefore, omitting the water from the Volkert reference clearly does not produce suitable foams.

Comparison Example 3 (see last paragraph on page 3, through 3rd paragraph on page 4 of the Declaration) demonstrates that omitting water from the formulation of Comparison Example 1, while increasing the Isocyanate Index and adding a trimerization catalyst to the formulation also does not result in a satisfactory foam. Rather, this foam, which has the same density as the foams produced in Comparison Examples 1 and 2, is dimensionally stable, but has a brittle surface.

This example dispels the Examiner's believe that by omitting water, increasing the NCO Index and adding a trimerization catalyst to the formulation of the Volkert reference, one "arrives at" the presently claimed invention. Applicants respectfully submit that this example is clearly outside the scope of the presently claimed invention as it does not contain from 10 to 20 parts by weight of compounds containing at least two isocyanate-reactive hydrogen atoms and having molecular weights of 32 to 399 as crosslinking agents. The presently claimed invention clearly requires a crosslinking agent as described above.

As an aside, Applicants note that N,N-dimethylcyclohexylamine used in the Examples of the Volkert reference, and thus, in the Comparison Examples set forth in the Declaration of Dr. Friederichs, is a polyurethane catalyst. N,N-dimethylcyclohexylamine obviously does not fall within the scope of the crosslinking agent, i.e. component 5), in the required combination of components for the presently claimed process.

Finally, Comparison Example 4 is similar to Comparison Example 3. It also does not contain water, increases the Isocyanate Index of the system in Comparison Example 1 from 114 to 500, and adds a trimerization catalyst. See Declaration, last full paragraph on page 4 through 3rd paragraph on page 5. This formulation also lacks a crosslinking agent. Like Comparison Example 3, this forms a foam which has a density similar to Comparison Example 1 (Example 1 of the Volkert reference), and is dimensionally stable, but extremely brittle. This Example also demonstrates the importance of the specific combination of components as presently required to Applicants' claimed process.

Applicants respectfully submit that the Declaration provides sufficient evidence that simply varying the Isocyanate Index of the various formulations and omitting water from these formulations results in foams which are dimensionally stable but exhibit surface brittleness. Only by combining the various components in their respective amounts as set forth in Applicants' claims is it possible to produce rigid foams which are dimensionally stable but not brittle. It is simply not apparent to one of ordinary skill in the art how to obtain these two properties simultaneously upon reading the Volkert reference.

The presently required combination of components is clearly necessary to produce flame resistant, dimensionally stable foams which are free of surface brittleness. The skilled artisan has no insight into the effect of this combination of components upon reading the Volkert et al reference. Only after reading Applicants' specification does this become apparent. Such a perspective does not, however, provide a proper basis for a rejection under 35 U.S.C. § 103. Accordingly, it is respectfully submitted that this reference does not fairly suggest the presently claimed invention.

In view of the above amendments and remarks, Applicants respectfully submit that each of these rejections is in error. Applicants respectfully request the rejection of Claims 3-9 as being obvious over the Volkert reference be withdrawn and Claims 3-9 be allowed.

Respectfully submitted,

By 

N. Denise Brown
Agent for Applicants
Reg. No. 36,097

Bayer Corporation
100 Bayer Road
Pittsburgh, Pennsylvania 15205-9741
(412) 777-8337
FACSIMILE PHONE NUMBER:
(412) 777-8363
s:\kgb\db1868res